Model CX-IR
Infrared Combustible Gas Sensors

Operator’s Installation and Instruction Manual
Covers all Model CX-IR Sensors

DETCON, Inc.
4055 Technology Forest Blvd, Suite 100
The Woodlands, Texas 77381
Phone: 713.559.9200 • Fax: 281.292.2860
www.detcon.com

May 29, 2014 • Document # 4428 • Revision 1.2
Table of Contents

1. Introduction ......................................................................................................................... 1
   1.1 Description ........................................................................................................................... 1
   1.2 Modular Design .................................................................................................................... 2
2. Installation ............................................................................................................................. 4
   2.1 Sensor Placement .................................................................................................................. 4
   2.2 Sensor Mounting .................................................................................................................... 6
   2.3 Electrical Installation .......................................................................................................... 7
   2.4 Field Wiring ......................................................................................................................... 7
      2.4.1 Terminal Connections 3-Wire 4-20mA ........................................................................ 8
      2.4.2 Terminal Connections 4-20mA and RS-485 ................................................................. 8
   2.5 Initial Start Up .................................................................................................................... 9
3. Operation ................................................................................................................................ 11
   3.1 Operator Interface ............................................................................................................... 12
   3.2 Normal Operation ............................................................................................................... 13
   3.3 Calibration Mode ................................................................................................................ 13
      3.3.1 AutoZero ...................................................................................................................... 14
      3.3.2 AutoSpan ...................................................................................................................... 15
   3.4 Program Mode .................................................................................................................... 16
      3.4.1 View Sensor Status .................................................................................................... 17
      3.4.2 Set Gas Type ................................................................................................................ 17
      3.4.3 Set AutoSpan Level ..................................................................................................... 18
      3.4.4 Set Gas Factor ............................................................................................................. 18
      3.4.5 Bump Test .................................................................................................................... 19
      3.4.6 Restore Defaults ......................................................................................................... 20
      3.4.7 Set Modbus™ ID ......................................................................................................... 20
   3.5 Fault Diagnostic/Failsafe Feature ..................................................................................... 21
4. Modbus™ Communications .................................................................................................... 22
   4.1 General Modbus™ Description ......................................................................................... 22
   4.2 Modbus™ Register Map & Description ............................................................................ 22
      4.2.1 Sensor Faults – Register 40005 .................................................................................. 23
5. Service and Maintenance ....................................................................................................... 25
   5.1 Replacement of Plug-in Sensor .......................................................................................... 25
   5.2 Replacement of ITM – Aluminum J-Box .......................................................................... 26
   5.3 Replacement of ITM – Stainless Steel Mini Condulet ..................................................... 26
6. Troubleshooting Guide ........................................................................................................... 28
   6.1 Under-Range problems .................................................................................................... 28
   6.2 Stability problems ............................................................................................................. 28
   6.3 Clearing problem ................................................................................................................ 28
   6.4 Poor Calibration Repeatability ......................................................................................... 29
   6.5 Unstable Output/ sudden spiking ...................................................................................... 29
   6.6 Nuisance Alarms ................................................................................................................ 29
   6.7 Intelligent Transmitter Module (ITM) not responding .................................................... 29
7. Customer Support and Service Policy ................................................................................ 30
   7.1 Warranty Notice ............................................................................................................... 30
   7.2 CX-IR Sensor Warranty .................................................................................................... 31
8. Appendix ................................................................................................................................ 32
   8.1 Specifications ..................................................................................................................... 32
   8.2 Spare Parts, Sensor Accessories, Calibration Equipment .............................................. 33
   8.3 Revision Log ........................................................................................................................ 34

Appendix ........................................................................................................................................... 32
Table of Figures

Figure 1 Sensor Cell Construction ....................................................................................................................... 1
Figure 2 Principle of Operation ............................................................................................................................ 2
Figure 3 Sensor Assembly Breakaway ................................................................................................................. 3
Figure 4 Functional Block Diagram ..................................................................................................................... 3
Figure 5 Plug-in Sensor ........................................................................................................................................ 3
Figure 6 Approval Label ...................................................................................................................................... 4
Figure 6 CX-IR Sensor with Lithium Battery Pack ............................................................................................. 6
Figure 7 Sensor Wire Connections ....................................................................................................................... 8
Figure 8 Terminal Interconnect ............................................................................................................................ 9
Figure 9 Magnetic Programming Tool ............................................................................................................... 11
Figure 10 Magnetic Programming Switches ...................................................................................................... 11
Figure 11 Software flow chart ............................................................................................................................ 13
Figure 12 Modbus™ Frame Format ................................................................................................................... 22
Figure 13 Sensor Cell and ITM Mating .................................................................................................................. 25

List of Tables

Table 1 Protection vs. Wire Gauge ....................................................................................................................... 7
Table 2 Gas Factors ............................................................................................................................................ 19
Table 3 CX-IR Register Map ............................................................................................................................. 23
1. Introduction

1.1 Description
Detcon Model CX-IR combustible gas sensors are non-intrusive “Smart” sensors designed to detect and monitor combustible hydrocarbon gases in the air with a detection range of 0-100% LEL (Lower Explosive Limit). The sensor features an LED display of current reading, fault and calibration status. A primary feature of the sensor is its method of automatic calibration, which guides the user through each step via fully scripted instructions illustrated on the LED display.

The microprocessor-supervised electronics are enclosed in an encapsulated module and housed in an explosion proof casting. The infrared detector is mounted in an intrinsically safe stainless steel housing and includes a Splash Guard Cal Adapter.

Non-Dispersive Infrared (NDIR) Optical Sensor Technology
The sensor technology is designed as a miniature plug-in replaceable component, which can easily be changed out in the field.

The NDIR sensor consists of (Figure 1);
- one infrared lamp source,
- two pyroelectric detectors (active and reference),
- and one optical gas sample chamber.

The lamp source produces infrared radiation, which interacts with the target gas as it is reflected through the optical gas sample chamber. The infrared radiation contacts each of the two pyroelectric detectors at the completion of the optical path. The active pyroelectric detector is covered by a filter specific to the part of the IR spectrum where the target gas absorbs light. The reference pyroelectric detector is covered by a filter specific to the non-absorbing part of the IR spectrum. When the target gas is present, it absorbs IR radiation and the signal output from the active detector decreases accordingly. The reference detector output remains unchanged. The ratio of the active and reference detector outputs are then used to compute the target gas concentration.

The technique is referred to as non-selective and may be used to monitor most any combustible hydrocarbon gas. Unlike catalytic bead type sensors, Detcon IR sensors are completely resistant to poisoning from corrosive gases and can operate in the absence of an oxygen background. The sensors are characteristically stable and capable of providing reliable performance for periods exceeding 5 years in most industrial environments.
Principle of Operation

The target gas diffuses through a stainless steel screen and into the volume of the sample gas optical chamber. An alternating miniature lamp provides a cyclical IR radiation source, which reflects through the optical gas sample chamber and terminates at the two pyroelectric detectors. The active and reference pyroelectric detectors each give an output which measures the intensity of the radiation contacting their surface. The active detector is covered by an optical filter specific to the part of the IR spectrum where the target gas absorbs light. The reference detector is covered by a filter specific to the non-absorbing part of the IR spectrum. When present, the target gas absorbs a fraction of the IR radiation and the signal output from the active detector decreases accordingly. The signal output of the reference detector remains unchanged in the presence of the target gas. The ratio of the active/reference signal outputs is then used to compute the target gas concentration. By using the ratio of the active/reference signal outputs, measurement drift caused by the changes in the intensity of the IR lamp source or changes in the optical path’s reflectivity is prevented (Figure 2).

Performance Characteristics

The IR sensor maintains strong sensitivity to most all combustible hydrocarbon gases within the LEL range. When compared with the typical catalytic bead LEL sensor, the IR sensor exhibits improved long-term zero and span stability. Typical zero calibration intervals are quarterly to semi-annual and typical span intervals are semi-annual to annual.

<table>
<thead>
<tr>
<th>NOTE</th>
<th>Actual field experience is always the best determination of appropriate calibration intervals.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOTE</td>
<td>The CX-IR sensor will not respond to combustible gases that are not hydrocarbons, such as H₂, NH₃, CO, H₂S…etc. It can only be used to measure hydrocarbon type gases.</td>
</tr>
</tbody>
</table>

The IR sensor generates different signal sensitivity levels for different combustible hydrocarbon target gases. Unless otherwise specified the CX-IR sensor will be factory calibrated for methane service. If the target hydrocarbon gas is other than methane, then the unit will have to be span calibrated and configured in accordance with this CX-IR sensor instruction manual.

1.2 Modular Design

The CX-IR sensor assembly is completely modular and is composed of four parts (Figure 3).

1. CX-IR Intelligent Transmitter Module (ITM)
2. Plug-in Infrared Sensor
3. CX Series Bottom Housing
4. Rain Shield
**NOTE**  All metal components are constructed from electro polished 316 Stainless Steel to maximize corrosion resistance in harsh environments.

**CX-IR Intelligent Transmitter Module**

The transmitter module is microprocessor-based and attached to the explosion proof junction box. Circuit functions include an intrinsically safe barrier, on-board power supply, microprocessor, magnetic programming switches, and a linear 4-20mA DC output. Magnetic program switches (located on either side of the ITM) are activated by a hand-held magnetic programming tool, allowing non-intrusive operator interface with the transmitter module. Electrical classifications are Class I, Div 1, Groups B, C, and D.

**Field Replaceable Sensor**

Detcon's infrared gas sensors are field proven, plug-in sensors with over-sized gold-plated connections that eliminate corrosion problems. The sensor can be accessed and replaced in the field easily by releasing the locking screw and unthreading the splashguard adapter assembly.
2. Installation

2.1 Hazardous Locations Installation Guidelines for Safe Use

1. Install the sensor only in areas with classifications matching the approval label. Follow all warnings listed on the label.

![Approval Label](image)

Figure 6 Approval Label

2. Do not remove the junction box cover while in the classified area unless it is confirmed there is no explosive gas levels in the area.

3. A good ground connection should be verified between the sensor’s metal enclosure and the junction box. If a good ground connection is not made, the sensor can be grounded to the junction box using the sensor’s external ground lug. Verify a good ground connection between the junction box and earth ground.

4. Proper precautions should be taken during installing and maintenance to avoid the build-up of static charge on the plastic components of the sensor (Rain Shield). Wipe with damp cloth on plastic components to avoid static discharge.

5. Do not substitute components. Substitution of components may impair the intrinsic safety rating.

6. Do not operate the sensor outside of the stated operating temperature limits.

7. Do not operate the sensor outside the stated operating limits for voltage supply.


9. These sensors have a maximum safe location voltage of Um=30V.

10. The CX-IR apparatus is not capable of withstanding the 500V insulation test required by clause 6.3.12 of IEC/EN 60079-11:2007 (and by clause 6.8.1 of CSA Std. 142); thus, the enclosure must be grounded.

11. The CXT-IR must only be combustible sensing cell model 371-IR1III1-000.
2.2 Sensor Placement

Sensor location is critical to the overall safe performance of the product. Confirm that the following five factors are verified during sensor placement.

1. Density of the gas to be detected
2. Most probable leak sources within the industrial process
3. Ventilation or prevailing wind conditions
4. Personnel exposure
5. Maintenance access

Density

Sensor placement should be relative to the density of the target gas. For the detection of heavier than air gases, sensors should be located within 4 feet of grade since heavy gases typically settle in low lying areas. For gases lighter than air, sensor placement should be 4 to 8 feet above grade in open areas or in pitched areas of enclosed spaces.

Leak Sources

The most leak sources in an industrial process are flanges, valves, and tubing connections where seals may either fail or wear. Other leak sources are best determined by facility engineers with experience in similar processes.

Ventilation

Normal ventilation or prevailing wind conditions can dictate efficient location of gas sensors in a manner where the movement of gas clouds is quickly detected.

Personnel Exposure

The undetected migration of gas clouds should not be allowed to approach concentrated personnel areas such as control rooms, maintenance or warehouse buildings. Selecting sensor location should combine leak source and perimeter protection in the best possible configuration.

Maintenance Access

Consideration should be given to providing easy access for maintenance personnel and the consequences of close proximity to contaminants that may cause the sensor to wear prematurely.

NOTE

In all installations, the gas sensor should point straight down. Improper sensor orientation may result in false readings and permanent sensor damage.

Additional Placement Considerations

The sensor should not be positioned where it might be sprayed or coated with surface contaminating substances. Painting sensor assemblies is prohibited.

Although the sensor is designed to be RFI resistant, it should not be mounted in close proximity to high-powered radio transmitters or similar RFI generating equipment.
When possible mount in an area void of high wind, accumulating dust, rain, splashing from hose spray, direct steam releases, and continuous vibration. If the sensor cannot be mounted away from potentially damaging conditions then use the Detcon's Harsh Location Dust Guard accessory.

Do not mount in locations where temperatures will exceed the operating temperature limits of the sensor. Use a sunshade to maintain correct operating temperature if mounted in direct sunlight.

### 2.3 Sensor Mounting

Vertically position the CX-IR so the sensor points straight down. The explosion-proof enclosure or junction box is typically mounted on a wall or pole. Detcon provides a selection of standard junction boxes in aluminum and stainless steel.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>If wall mounting without a mounting plate, make sure to use at least 1/2&quot; spacers underneath the aluminum junction boxes 1/4&quot; mounting holes to move the sensor assembly away from the wall and to allow access to the sensor assembly.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal-on-metal contact must be maintained to provide a solid electrical ground path. Only use Teflon Tape or other pipe thread material on the 3/4&quot; threads if the sensor is mounted in a severe or harsh environment. If Teflon Tape is used the Sensor must be externally grounded using a ground strap.</td>
</tr>
</tbody>
</table>

**Figure 7** CX-IR Sensor with Lithium Battery Pack
When mounting on a pole, secure the junction box to a suitable mounting plate and attach the mounting plate to the pole using U-Bolts. (Pole-Mounting brackets for Detcon junction boxes are available separately.)

### 2.4 Electrical Installation

The sensor assembly wiring should be installed in accordance with local electrical codes. Proper electrical installation of the gas sensor is critical for conformance to electrical codes and to avoid damage due to water leakage.

If a conduit run exists, a drain should be incorporated. The drain allows condensation inside the conduit run to drain safely away from the sensor assembly. Electrical seals act as a secondary seal to prevent water from entering the wiring enclosure. However, electrical seals are not designed to provide an absolute watertight seal, especially when used in the vertical orientation. The electrical seal fitting is required to meet the National Electrical Code per NEC Article 500-3d (or Canadian Electrical Code Handbook Part 1 Section 18-154). Requirements for locations of electrical seals are covered under NEC Article 501-5.

**NOTE**

A conduit seal is required to be located within 18” of the J-Box and sensor assembly. Crouse Hinds type EYS2, EYD2 or equivalent are suitable for this purpose.

**NOTE**

Water damage from water leaking into the enclosure is not covered by the Detcon warranty.

**NOTE**

Unused ports should be blocked with suitable 3/4” male NPT plug. Detcon supplies one 3/4” NPT male plug with each J-box enclosure. If connections are other than 3/4” NPT, use an appropriate male plug of like construction material.

**CAUTION**

Do not apply system power to the sensor until all wiring is properly terminated (Section 2.5).

### 2.5 Field Wiring

Detcon Model CX-IR sensor assemblies require three conductor connections between power supplies and host electronic controller’s 4-20mA output. Wiring designations are + (DC), – (DC), and mA (sensor signal. Maximum wire ohmic resistance between sensor and 24VDC source is defined below. Maximum wire size for termination in the Detcon J-Box accessory is 14 gauge.

Max Resistance drop on red and black wire is 10 ohms. This considers wire diameter, wire length and maximum operation temperature.

Max loop load resistance between green and black wire is 500 ohms. Minimum loop load resistance between green and black wire is 100 ohms. This is considers wire diameter, wire length, max operating temperature and selected termination resistor.

<table>
<thead>
<tr>
<th>AWG</th>
<th>Wire Dia.</th>
<th>Over-Current Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>0.723mm</td>
<td>3A</td>
</tr>
<tr>
<td>20</td>
<td>0.812mm</td>
<td>5A</td>
</tr>
<tr>
<td>18</td>
<td>1.024mm</td>
<td>7A</td>
</tr>
<tr>
<td>16</td>
<td>1.291mm</td>
<td>10A</td>
</tr>
<tr>
<td>14</td>
<td>1.628mm</td>
<td>20A</td>
</tr>
</tbody>
</table>

Table 1 Protection vs. Wire Gauge
NOTE 1: Wiring table is based on stranded tinned copper wire and is designed to serve as a reference only.

NOTE 2: Shielded cable is required for installations where cable trays or conduit runs include high voltage lines or other possible sources of induced interference. Separate conduit runs are highly recommended in these cases.

NOTE 3: The supply of power should be from an isolated source with over-current protection as stipulated in table.

2.5.1 Terminal Connections 3-Wire 4-20mA

CAUTION: Do not apply System power to the sensor until all wiring is properly terminated. Refer to Section 2.5 Initial Start Up

Figure 8 Sensor Wire Connections

a) Remove the junction box cover. Identify the terminal blocks for customer wire connections.

b) Observing correct polarity, terminate the 3-conductor 4-20mA field wiring (+, -, mA) to the sensor assembly wiring in accordance with the detail shown in Figure 8.

c) Replace the junction box cover.

2.5.2 Terminal Connections 4-20mA and RS-485

1. Remove the junction box cover.
2. Connect the incoming 24V to the terminal labeled "+" and 24V return to the terminal labeled "-". Connect the mA output to the “mA” terminal and the Modbus signals (if used) to the “A” and “B” terminals. Note: the “Y” terminal is not used.

3. Replace the junction box cover after Initial Start Up (Section 2.6).

NOTE

A 6-32 or 8-32 threaded exterior ground point is provided on most junction boxes for an external ground. If the sensor assembly is not mechanically grounded, an external ground strap must be used to ensure that the sensor is electrically grounded.

2.6 Initial Start Up

Combustible Gas Sensors

Upon completion of all mechanical mounting and field wiring, apply power to the unit. If the unit is equipped with the optional power switch, power is applied by pushing the switch. Observe the following normal conditions:

1. Upon power up, the sensor will scroll CX-IR and will then display the current reading for approximately 5 seconds. A temporary upscale reading may occur as the sensor stabilizes. This upscale reading will decrease to 0% LEL within 1 to 2 minutes of power-up, assuming there is no gas in the area of the sensor.

2. After the initial power up, the sensor display will turn off. Thereafter the display will come on once every 10 seconds and will display the current reading for about 2 seconds, and will return to a blank display to conserve battery power.

NOTE

In normal operation the display will come on once every 10 seconds, will display the current reading for about 2 seconds, and will return to a blank display to conserve battery power.
Initial Operational Tests

After a warm up period of 1 hour (or when zero has stabilized), the sensor should be checked to verify sensitivity to the target gas.

Material Requirements

- Splash Guard with integral Cal Port and with Wind Guard (Detcon PN 613-120000-700) -or-
- Threaded Calibration Adapter (Detcon PN 943-000006-132) - or -
- Teflon Calibration Adapter for highly reactive gases (Detcon PN 943-01747-T05)
- Detcon Span Gas; 50% of range target gas in balance N2 or Air at fixed flow rate between 200-500cc/min (500cc/min is preferred)

12. Attach the calibration adapter to the Splashguard Adapter Assembly or connect tubing to integral cal port. It is recommended that the Wind Guard (Detcon PN 943-000000-000) is installed over the Splash Guard during calibration.

13. Apply the test gas at a controlled flow rate of 200 - 500cc/min (500cc/min is the recommended flow). Observe that the ITM display increases to a level near that of the applied calibration gas value.

**NOTE** Wind Guard must be used when calibrating with the integral cal port to ensure proper calibration.

14. Remove test gas and observe that the display decreases to 0.

15. If a calibration adapter was used during these tests, remove it from the unit, and re-install the Splash Guard.

16. If the wind guard was used, remove the wind guard.

Initial operational tests are complete.

CX-IR Combustible gas sensors are factory calibrated prior to shipment, and should not require significant adjustment on start up. However, it is recommended that a complete calibration test and adjustment be performed 16 to 24 hours after power-up. Refer to calibration instructions in Section 3.3.
3. Operation

The operator interface of the CX Series gas sensors is accomplished with two internal magnetic switches located to either side of the LED display (Figure 10). The two switches, labeled PGM1 and PGM2, allow for complete calibration and configuration, eliminating the need for area de-classification or the use of hot permits.

![Figure 10 Magnetic Programming Tool](image)

The magnetic programming tool (Figure 10) is used to operate the magnetic switches. Switch action is defined as momentary contact (a swipe), a 3-second hold, and a 10-second hold. (Hold times are defined as the time from the point when the arrow prompt appears. Swiping the magnet does not display the arrow prompt.) For momentary contact use, the programming magnet is briefly held over a switch location, or swiped. For 3-second hold, the programming magnet is held in place over the switch location for three seconds. For 10-second hold, the programming magnet is held in place over the switch location for 10 seconds. The 3 and 10 second holds are generally used to enter calibration/program menus and save new data. The momentary contact is generally used to move between menu items and to modify set-point values. Arrows (◄ and ►) are used on the LED display to indicate when the magnetic switches are activated. The location of PGM1 and PGM2 are shown in Figure 11.

![Figure 11 Magnetic Programming Switches](image)

| NOTE | While in Program Mode, if there is no magnetic switch interaction after 4 consecutive menu scrolls, the sensor will automatically revert to normal operating condition. While changing values inside menu items, **if there is no magnet activity after 3 to 4 seconds the sensor will revert to the menu scroll.** If the sensor is in Bump Test mode, the display will remain active. |

---

DETCON #3270  
PROGRAMMING MAGNET

LED Display

Programming Switch #1

MODEL

Programming Switch #2

CX-IR Instruction Manual  Rev. 1.2  Page 11 of 34
3.1 Operator Interface

The operating interface is menu-driven via the two magnetic program switches located under the target marks of the sensor housing. The two switches are referred to as PGM1 and PGM2. The menu list consists of three menu items that include sub-menus:

Normal Operation

Concentration reading is displayed once every 10 seconds.

Calibration Mode

AutoZero
AutoSpan

Program Mode

View Sensor Status
  CX-IR ##.##
  Serial Number
  Range ###
  Autospan Level ##
  Modbus ID ##
  Last Cal ## Days
  Sensor Life ###%
  Temperature ###C

Set Gas Type
Set Autospan Level
Set Gas Factor
Set Modbus ID
Bump Test
Restore Defaults
3.2 Normal Operation

In normal operation, the Intelligent Transmitter Module (ITM) display will be blank and will display the gas reading once every 10 seconds for about 2 seconds (normally appear as "0"). At any time, swiping a magnet across either PGM1 or PGM2 will cause the ITM to display the range and gas type (i.e. "ppm H2S"). If the sensor is actively experiencing any diagnostic faults, a swipe of the magnet will cause the display to scroll the fault condition. Refer to Section 5 Service and Maintenance for more information on fault conditions.

3.3 Calibration Mode

Zero and span calibration should be performed on a routine basis (quarterly minimum is advised) to ensure reliable performance. If a sensor has been exposed to any de-sensitizing gases, or to very high over-range combustible gas levels, re-calibration should be considered. Unless otherwise specified, span adjustment is recommended at 50% of the full scale range.

To enter calibration mode hold the magnet over PGM1 for 3 seconds. If the sensor is experiencing a fault condition the "►" prompt will not appear until the fault(s) have been displayed. When the ITM enters
calibration mode the display will scroll **Pgm1=Zero  Pgm2=Span** twice before returning to normal mode (about 5 seconds).

---

**NOTE**

Upon entering calibration mode, the Modbus™ status register bit 14 is set to signify the sensor is in-calibration mode. This bit will remain set until the program returns to normal operation.

---

### 3.3.1 AutoZero

The AutoZero function is used to zero the sensor. AutoZero should be performed periodically or as required. AutoZero should be considered after periods of over-range target gas exposure. Local ambient air can be used to zero calibrate a combustible gas sensor as long as it can be confirmed that it contains no target or interference gasses. If this cannot be confirmed then a zero air or N₂ cylinder should be used.

**Material Requirements:**

- DetconMicroSafe™ Programming Magnet (PN 327-000000-000)
- Splash Guard with integral Cal Port (Detcon P/N 613-120000-700) and Calibration Wind Guard (Detcon PN 613-120000-700) -or-
- Threaded Calibration Adapter (Detcon PN 943-000006-132)
- Detcon Zero Air cal gas (PN 942-001123-000) (or use ambient air if no target gas is present)
- Detcon Nitrogen 99.99% (PN 942-640023-100)

**NOTE**
The zero gas source may be zero air or N₂ if local ambient air contains target or interference gases.

**NOTE**
The Calibration Wind Guard must be used when the Splashguard Adapter with integral Cal Port is used. Failure to use the Calibration Wind Guard may result in an inaccurate AutoZero calibration.

---

a) For combustible gas sensors, if the ambient air is known to contain no target gas content, then it can be used for zero calibration. If a zero gas cal cylinder is going to be used, attach the calibration adapter and set flow rate of 200-500cc/min (500cc/min is the recommended flow rate) and let sensor purge for 1 to 2 minutes before executing the **AutoZero**.

b) From normal operation, enter calibration mode by holding the programming magnet over **PGM1** for 3 seconds The display will then scroll **Pgm1=Zero  Pgm2=Span**. Hold the programming magnet over **PGM1** for 3 seconds once the "◄" prompt appears to execute **AutoZero** (or allow to timeout in 5 seconds if AutoZero is not desired).

**NOTE**
The "◄" prompt will show that the magnetic switch is activated during the 3 second hold period.

---

**NOTE**

Upon entering calibration mode, the Modbus™ status register bit 14 is set to signify the sensor is in-calibration mode. This bit will remain set until the program returns to normal operation.

---

c) The ITM will display the following sequence of text messages as it proceeds through the **AutoZero** sequence:

```
Zero Cal . . . Setting Zero . . . Zero Saved (each will scroll twice)
```
d) Remove the zero gas and calibration adapter, if applicable.

### 3.3.2 AutoSpan

The AutoSpan function is used to span calibrate the sensor. AutoSpan should be performed periodically or as required. AutoSpan should be considered after periods of over-range target gas exposure. Unless otherwise specified, span adjustment is recommended at 50% of range.

**NOTE** Before performing AutoSpan calibration, verify that the AutoSpan level matches the span calibration gas concentration as described in Section 3.4.3 Set AutoSpan level.

**Material Requirements:**
- Detcon MicroSafe™ Programming Magnet (PN 327-000000-000)
- Splash Guard with integral Cal Port (Detcon P/N 613-120000-700) and Calibration Wind Guard (Detcon PN 613-120000-700)
- Threaded Calibration Adapter (Detcon PN 943-000006-132)
- Detcon Span Gas. Recommended span gas is 50% of range with target gas. Other suitable span gas sources containing the target gas in air or N\textsubscript{2} balance are acceptable.

**NOTE** Contact Detcon for ordering information on span gas cylinders.

**NOTE** A target gas concentration of 50% of range is strongly recommended. This should be supplied at a controlled flow rate of 200 to 500cc/min, with 500cc/min being the recommended flow rate. Other concentrations can be used if they fall within allowable levels of 5% to 100% of range.

**NOTE** The Calibration Wind Guard must be used when the Splashguard Adapter with integral Cal Port is used. Failure to use the Calibration Wind Guard may result in an inaccurate AutoZero calibration.

**NOTE** It is generally not advised to use other gasses to cross-calibrate for span. Cross-calibration by use of other gasses should be confirmed by Detcon.

**CAUTION** Verification that the calibration gas level setting matches the calibration span gas concentration is required before executing AutoSpan calibration. These two numbers must be equal.

AutoSpan consists of entering calibration mode and following the displayed instructions. The display will ask for the application of span gas in a specific concentration. The applied gas concentration must be equal to the calibration gas level setting. The factory default setting and recommendation for span gas concentration is 50% of range. If a span gas containing the recommended concentration is not available, other concentrations may be used as long as they fall between 5% and 95% of range. However, any alternate span gas concentration value must be programmed via the Set AutoSpan Level menu before proceeding with AutoSpan calibration.

- a) Verify that the AutoSpan level is equal to the calibration span gas concentration. (Refer to View Sensor Status in Section 3.4.1.) If the AutoSpan level is not equal to the calibration span gas concentration, adjust the AutoSpan level as instructed in Section 3.4.3.

- b) From normal operation, enter calibration mode by holding the programming magnet over PGM1 for 3 seconds.
The "◄" prompt will show that the magnetic switch is activated during the 3 second hold period.

c) The display will scroll ‘PGM1=Zero    PGM2=Span’. Hold the programming magnet over PGM2 for 3 seconds to execute AutoSpan (or allow to timeout in 5 seconds if AutoSpan is not intended). The ITM will scroll ‘Apply XX % Gas’.

d) Apply the span calibration test gas for combustible gas sensors at a flow rate of 200-500cc/min (500cc/min is the recommended flow rate). As the sensor signal begins to increase the display will switch to flashing XX reading as the ITM shows the sensor's as found response to the span gas presented. If it fails to meet the minimum in-range signal change criteria within 2 minutes, the display will report Range Fault twice and the ITM will return to normal operation, aborting the AutoSpan sequence. The ITM will continue to report a Range Fault until a successful calibration is completed.

e) Assuming acceptable sensor signal change, after 1 minute the reading will auto-adjust to the programmed AutoSpan level. The ITM then reports the following messages: ‘Remove Gas’.

f) Remove the span gas source and calibration adapter. The ITM will report a live reading as it clears toward 0. When the reading clears below 10% of range, the ITM will display ‘Span Complete’ and will revert to normal operation. If the sensor fails to clear to less than 10% in less than 5 minutes, a ‘Clearing Fault’ will be reported twice and the ITM will return to normal operation, aborting the AutoSpan sequence. The ITM will continue to report a Clearing Fault until a successful calibration is completed.

g) AutoSpan calibration is complete.

NOTE If the sensor fails the minimum signal change criteria, a Range Fault will be declared and the Range Fault bit will be set on the Modbus™ output.

NOTE If the sensor fails the clearing time criteria, a Clearing Fault will be declared and the Clearing fault bit will be set on the Modbus™ output.

3.4 Program Mode

Program Mode provides menus to check and set operational and configuration parameters of the sensor. Program Mode provides for adjustment of the AutoSpan Level, Gas Factor, Gas Type and Range, and Serial ID. Program mode includes the diagnostic function bump test and restores defaults.

The Program Mode menu items appear in the order presented below:

View Sensor Status
Set Gas Type
Set AutoSpan Level
Set Gas Factor
Bump Test
Set Modbus™ ID
Restore Defaults

Navigating Program Mode

From normal operation, enter program mode by holding the magnet over PGM2 for 3 seconds. The "►" prompt will verify that the magnetic switch is activated. If the sensor is experiencing a fault condition the "►" prompt will not appear until the fault(s) have been displayed.
NOTE The arrow prompts (◄ and ►) will show that the magnetic switch is activated during the 3 second hold period.

The ITM will enter program mode and the first menu item View Sensor Status will be displayed. Hold the magnet over PGM1 or PGM2 while the current menu text is scrolling to advance to the next menu item.

At the conclusion of the text scroll the arrow prompt ("►" for PGM2 or "◄" for PGM1) will appear, immediately remove the magnet. The ITM will advance to the next menu item. Repeat this process until the desired menu item is displayed.

NOTE PGM1 moves the menu items from right to left and PGM2 moves the menu items from left to right.

To enter a menu item, hold the magnet over PGM1 or PGM2 while the menu item is scrolling. At the conclusion of the text scroll the "►" prompt ("►" for PGM2 or "◄" for PGM1) will appear, continue to hold the magnet over PGM1 or PGM2 for an additional 3 to 4 seconds to enter the selected menu item. If there is no magnet activity while the menu item text is scrolling (typically 4 repeated text scrolls), the ITM will automatically revert to Normal Operation.

3.4.1 View Sensor Status

View Sensor Status displays all current configuration and operational parameters including:

- CX-IR ##.##
- Serial Number
- Range ###
- Autospan Level ##
- Modbus ID ##
- Last Cal ## Days
- Sensor Life ###%
- Temperature ##°C

From the View Sensor Status text scroll, hold the magnet over PGM1 or PGM2 until the arrow prompt appears and continue to hold the magnet in place for an additional 3 to 4 seconds (until the display starts to scroll Status Is). The display will scroll the complete list of sensor status parameters sequentially.

When the status list sequence is complete, the ITM will revert to the View Sensor Status text scroll. The user can either:
- review list again by executing another 3 to 4 second hold,
- move to another menu item by executing a momentary hold over PGM1 or PGM2, or
- return to normal operation via automatic timeout of about 15 seconds (the display will scroll View Sensor Status four times and then return to normal operation).

3.4.2 Set Gas Type

The IR sensor has a slightly different linearization requirement for different groupings of target gases. The two selections are:

- %LEL and
- %VOL.
The Set Gas Type menu function is a simple choice between these two gas type groupings.

**NOTE**  The default value for Gas Type is methane (%LEL).

The menu item appears as: **Set Gas Type**.

From the Set Gas Type and Range text scroll, hold the magnet over PGM1 or PGM2 until the arrow prompt appears and continue to hold the magnet in place for an additional 3 to 4 seconds (until the display starts to scroll %LEL / %VOL). Swipe the magnet momentarily over PGM2 or PGM1 to change the selection until the correct choice is displayed. Hold the magnet over PGM1 or PGM2 for 3 seconds to accept the new value. The display will scroll **Type Saved**, then **Set Range** followed by the currently selected Range. Momentarily hold the magnet over PGM1 or PGM2 to change the Range Selection until the correct value is displayed. Hold the magnet over PGM2 for 3 seconds to accept the new value.

Move to another menu item by executing a momentary hold, or, return to normal operation via automatic timeout of about 15 seconds (the display will scroll **Set Gas Type** 4 times and then return to normal operation).

### 3.4.3 Set AutoSpan Level

**Set AutoSpan Level** is used to set the span gas concentration level used to calibrate the sensor. This level is adjustable from 5% to 95% of range. The current setting can be viewed in **View Program Status**.

The menu item appears as: **Set AutoSpan Level**.

From the **Set AutoSpan Level** text scroll, hold the magnet over PGM1 or PGM2 until the "►" prompt appears and continue to hold the magnet in place for an additional 3-4 seconds (until the display starts to scroll **Set Level**). The display will switch to XX (where XX is the current gas level).

Swipe the magnet momentarily over PGM2 to increase or PGM1 to decrease the AutoSpan Level until the correct level is displayed. When the correct level is achieved, hold the magnet over PGM2 for 3 to 4 seconds to accept the new value. The display will scroll **Level Saved**, and revert to **Set AutoSpan Level** text scroll.

Move to another menu item by executing a momentary hold, or return to normal operation via automatic timeout of about 15 seconds (the display will scroll **Set AutoSpan Level** 4 times and then return to normal operation).

### 3.4.4 Set Gas Factor

Because of the CX-IR sensor's almost universal response to combustible hydrocarbon gases, the CX-IR sensor can be configured and calibrated to detect a variety of combustible gases. The detected gas is referred to as the "target gas" and the span calibration gas is referred to as the "cal gas". In cases where the cal gas is different from the target gas, the Set Gas Factor menu function is used to maintain accuracy. This feature allows for a significant degree of flexibility in the detection and span calibration process.

**NOTE**  The default value for Gas Factor is 1.0. This would be used when the target gas is the same as the cal gas.

**Set Gas Factor** is used to make the appropriate signal sensitivity adjustment when the target gas is different from the cal gas. This is necessary because the IR sensor has different signal strengths for each combustible hydrocarbon gas. The Gas Factor value is adjustable from 0.2 to 5.0. It represents the translation between the target gas and the cal gas when they are different.
The menu item appears as: **Set Gas Factor.**

To calculate the correct Gas Factor (Table 2), take the Gas Factor of the target gas and divide by the Gas Factor of the cal gas. The calculated value is the correct number to enter into the menu as the Gas Factor.

For example, if calibrating with methane when propane is the target gas, the correct Gas Factor to enter would be $0.63/1.0 = 0.63$.

For example, if calibrating with butane when ethane is the target gas, the correct Gas Factor to enter would be $0.38/0.72=0.53$.

Table 2 shows the Gas Factors of most combustible hydrocarbon gases that will be measured. Find the gas of interest for the cal gas and the target gas and follow the above instruction. If there is a mixture of target gases, use a weighted approach to determine the correct Gas Factor.

For example, if the target gas was 50% butane and 50% pentane and the cal gas was methane, the correct Gas Factor would be calculated and entered as $((0.5 \times 0.77) + (0.5 \times 0.77)) / 1.0 = 0.77$.

<table>
<thead>
<tr>
<th>Gas</th>
<th>Factor</th>
<th>Gas</th>
<th>Factor</th>
<th>Gas</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic Acid</td>
<td>2.00</td>
<td>Decane</td>
<td>1.53</td>
<td>Naphthalene</td>
<td></td>
</tr>
<tr>
<td>Acetone</td>
<td>1.21</td>
<td>Ethyl Alcohol</td>
<td>0.35</td>
<td>n-Nonane</td>
<td>1.53</td>
</tr>
<tr>
<td>Benzene</td>
<td>1.00</td>
<td>Ethane</td>
<td>0.38</td>
<td>n-Octane</td>
<td>1.34</td>
</tr>
<tr>
<td>1,3-Butadiene</td>
<td>1.80</td>
<td>Ethyl Benzene</td>
<td>1.07</td>
<td>n-Pentane</td>
<td>0.77</td>
</tr>
<tr>
<td>Butane</td>
<td>0.77</td>
<td>Ethylene</td>
<td>2.39</td>
<td>Propane</td>
<td>0.63</td>
</tr>
<tr>
<td>Iso-Butane</td>
<td>0.72</td>
<td>n-Heptane</td>
<td>0.98</td>
<td>iso-Propyl Alcohol</td>
<td>0.54</td>
</tr>
<tr>
<td>Butene-1</td>
<td>0.67</td>
<td>n-Hexane</td>
<td>1.00</td>
<td>Propylene</td>
<td>0.80</td>
</tr>
<tr>
<td>n-Butyl Alcohol</td>
<td>0.63</td>
<td>Dimethyl Ether</td>
<td>0.40</td>
<td>Toluene</td>
<td>1.00</td>
</tr>
<tr>
<td>iso-Butyl Alcohol</td>
<td>0.63</td>
<td>Methane</td>
<td>1.00</td>
<td>Vinyl Acetate</td>
<td>1.43</td>
</tr>
<tr>
<td>Cyclohexane</td>
<td>0.89</td>
<td>Methanol</td>
<td>0.41</td>
<td>Vinyl Chloride</td>
<td></td>
</tr>
<tr>
<td>Cyclopropane</td>
<td>0.45</td>
<td>Methyl Ethyl Ketone</td>
<td>0.77</td>
<td>Xylene</td>
<td>1.00</td>
</tr>
</tbody>
</table>

From the Set Gas Factor text scroll, hold the magnet over PGM1 or PGM2 until the arrow prompt appears and continue to hold the magnet in place for an additional 3 to 4 seconds (until the display starts to scroll Set Factor). The display will then switch to X.XX (where X.XX is the current gas factor). Swipe the magnet momentarily over PGM2 to increase or PGM1 to decrease the gas factor level until the correct value is displayed. Hold the magnet over PGM2 for 3 seconds to accept the new value. The display will scroll Factor Saved, and revert to Set Gas Factor text scroll.

Move to another menu item by executing a momentary hold, or, return to normal operation via automatic timeout of about 15 seconds (the display will scroll Set Gas Factor four times and then return to normal operation).

### 3.4.5 Bump Test

Bump test checks the response of the sensor with the indication of response limited to the display only. The bump test mode allows the performance of the sensor to be checked without firing the alarms of any attached control systems. The results of the bump test will not affect the reading register on the Modbus™ output.

The menu item appears as: **Bump Test**

From the Bump Test text scroll, hold the magnet over PGM1 or PGM2 until the "►" prompt appears and continue to hold the magnet in place for an additional 3 to 4 seconds (until the display starts to scroll Bump Test Started).
Apply span gas to the sensor in accordance with Section 0. The sensor will respond to the gas testing the sensor response while the current Modbus gas reading (Modbus register 0002) remains unchanged. Remove the gas before the bump test time expires (2 minutes).

The display will return to normal operation alternating between the live gas reading and showing Bump until 2 minutes expires or the execution of a momentary hold over PGM1 or PGM2, when the display will scroll Bump Test Ended.

### 3.4.6 Restore Defaults

**Restore Factory Defaults** clears the current user configuration and calibration data from memory and reverts back to factory default values. Returning to a factory default is common when settings have been configured improperly and a known reference point needs to be re-established to correct the problem.

This menu item appears as: **Restore Defaults**.

From the **Restore Defaults** scroll, hold the programming magnet over PGM2 until the "►" prompt appears and continue to hold for 3 to 4 seconds. The display will scroll Defaults Restored, and revert to **Restore Defaults** text scroll.

Move to another menu item by executing a momentary hold or, return to normal operation by the automatic timeout of about 15 seconds (the display will scroll **Restore Defaults** 4 times and return to normal operation).

Following the execution of **Restore Defaults**, the CX-IR will revert to its factory default settings. The default settings are as follows:

**NOTE** The following must be performed in order before the sensor can be placed in operation.

- **Gas Type**: The Gas Type default is %LEL. If the gas type was changed the gas type will need to be reset by the user (Section 3.4.2).
- **AutoSpan Level** = 50% of range. AutoSpan level must be set appropriately by the operator (Section 3.4.3).
- **Gas Factor**: The default Gas Factor is 1. If the units was set to a different gas factor it will need to be reset by the user (Section 3.4.4).
- **Modbus ID** = 01. The Modbus ID must be set appropriately by the user (Section 3.4.7).
- **AutoZero**: AutoZero Settings are lost and user must perform new AutoZero (Section 3.3.1).
- **AutoSpan**: AutoSpan Settings are lost and user must perform new AutoSpan (Section 3.3.2).

### 3.4.7 Set Modbus™ ID

The CX-IR sensor can be polled serially via RS-485 Modbus™ RTU. **Set Modbus™ ID** is used to set the Modbus™ serial ID address. The Modbus™ is adjustable from 01 to 256 in hexadecimal format (01-FF) hex. Each sensor must have a unique Modbus address to operate correctly on the network. The current serial ID can be viewed in View Sensor Status.

The menu item appears as: **Set Modbus™ ID**.
From the **Set Modbus ID** scroll, hold the programming magnet over PGM1 or PGM2 until the "►" prompt appears and continue to hold the magnet in place for an additional 3 to 4 seconds (until the display starts to scroll **Set ID**). The display will then switch to XX (where XX is the current ID address).

Swipe the magnet over PGM2 to increase or PGM1 to decrease the hexadecimal number until the desired ID is displayed. Hold the magnet over PGM2 for 3 to 4 seconds to accept the new value. The display will scroll **ID Saved**, and revert to **Set Modbus ID** text scroll.

Move to another menu item by executing a momentary hold or, return to normal operation by automatic timeout of about 15 seconds (the display will scroll **Set Serial ID** 5 times and return to normal operation).

### 3.5 Fault Diagnostic/Failsafe Feature

If the ITM should incur a fault, the Global Fault bit will be set on the Modbus™ output. This can occur if the ITM detects a problem with the sensor, detects that there is no sensor connected, if the ITM has an internal fault, or other fault condition. The Global Fault bit will be set on the Modbus™ output until the problem is resolved. The display will show the Fault when a magnetic programming tool is swiped across either PGM1 or PGM2. The error codes are defined in Section 6 Troubleshooting.
4. Modbus™ Communications

Model CX-IR sensors feature Modbus™ compatible communications protocol and are addressable via the operator interface. Communication is two wire, half duplex 485, 9600 baud, 8 data bits, 1 stop bit, and no parity. If a multi-point system is being utilized, each sensor should be set for a different address. Typical address settings are: 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B, 0C, 0D, 0E, 0F, 10, 11…etc.

Sensor RS-485 ID numbers are factory default to 01 and can be changed in the field using the operator interface (Section 3.5.5).

4.1 General Modbus™ Description

The Modbus™ communication uses the RTU transmission mode per the Modbus™ specification. The basic frame format for Modbus™ consists of a Modbus™ address, function code, data and CRC.

```
<table>
<thead>
<tr>
<th>Address Field</th>
<th>Function Code</th>
<th>Data</th>
<th>CRC</th>
</tr>
</thead>
</table>
```

Figure 13 Modbus™ Frame Format

The Modbus ID Field is the unique Modbus™ address of each device on the network. The Function Code is the function to be performed. The Data contains read or write data and is formatted according to the function being performed. The CRC (Cyclic Redundancy Code) is used to detect errors in the frame. Frames with errors are invalid and ignored.

Modbus™ transactions consist of a request by the controller and response from the device being addressed so there are two frames transferred for every transaction. Every request is evaluated by the CX-IR to determine if it is addressed, and if it falls within the register address range. If these two conditions are true, the CX-IR will then verify a valid Function Code. Function Codes supported by the CX-IR are as follows:

- Function Code 03 (03h) – Read Holding Registers
- Function Code 06 (06h) – Write Single Register
- Function Code 16 (10h) – Write Multiple Registers

If an invalid function code is performed, the CX-IR will ignore the request.

4.2 Modbus™ Register Map & Description

When the CX-IR is assigned a Modbus™ address, the following registers become available to the controller for access. All CX-IR sensors implement this register set. Some registers are Read Only (R) and others are Read/Write (R/W) as shown by the R/W column. This equates to specific function codes where Read is function code 03 and Write is function code 06 or 16.

**NOTE** A write to a Read Only register is allowed and returns a response, but it does not change the value of the register.

Table 3 is the register map for the CX-IR sensor and gives a brief description each register or register set. This information is only meant as a reference. For a more detailed description of the Register Map please contact Detcon.
Table 3 CX-IR Register Map

<table>
<thead>
<tr>
<th>Register</th>
<th>Name</th>
<th>R/W</th>
<th>Meaning</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>40000</td>
<td>CX-IR Device Type</td>
<td>R</td>
<td>= 42</td>
<td></td>
</tr>
<tr>
<td>40001</td>
<td>Range</td>
<td>R/W</td>
<td>Detectable Range</td>
<td>%LEL</td>
</tr>
<tr>
<td>40002</td>
<td>Reading</td>
<td>R</td>
<td>Current Gas Reading</td>
<td>%LEL</td>
</tr>
<tr>
<td>40003</td>
<td>Calibration Level</td>
<td>R/W</td>
<td>Auto Span Level</td>
<td>%LEL</td>
</tr>
<tr>
<td>40004</td>
<td>Life</td>
<td>R</td>
<td>Sensor Life</td>
<td>%</td>
</tr>
<tr>
<td>40005</td>
<td>Sensor Faults</td>
<td>R</td>
<td>See Section 4.2.1</td>
<td></td>
</tr>
<tr>
<td>40006</td>
<td>Sensor Model</td>
<td>R</td>
<td>IR (set to 3)</td>
<td></td>
</tr>
<tr>
<td>40007</td>
<td>Days since Calibration</td>
<td>R</td>
<td></td>
<td>days</td>
</tr>
<tr>
<td>40008</td>
<td>Reserved</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40009</td>
<td>Reserved</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40010</td>
<td>Sensor Temperature</td>
<td>R</td>
<td></td>
<td>ºC</td>
</tr>
<tr>
<td>40011</td>
<td>Gas Factor</td>
<td>R/W</td>
<td>See Section 3.4.4</td>
<td></td>
</tr>
<tr>
<td>40012</td>
<td>Reserved</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40013</td>
<td>Reserved</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40014</td>
<td>Range Divisor</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40015</td>
<td>Calibration Enable/Status</td>
<td>R/W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40016</td>
<td>Gas Type/Units String</td>
<td>R</td>
<td>ASCII Text (set at factory)</td>
<td></td>
</tr>
<tr>
<td>40017</td>
<td>Gas Type/Units String</td>
<td>R</td>
<td>ASCII Text (set at factory)</td>
<td></td>
</tr>
<tr>
<td>40018</td>
<td>Gas Type/Units String</td>
<td>R</td>
<td>ASCII Text (set at factory)</td>
<td></td>
</tr>
<tr>
<td>40019</td>
<td>Gas Type/Units String</td>
<td>R</td>
<td>ASCII Text (set at factory)</td>
<td></td>
</tr>
<tr>
<td>40020</td>
<td>Gas Type/Units String</td>
<td>R</td>
<td>ASCII Text (set at factory)</td>
<td></td>
</tr>
<tr>
<td>40021</td>
<td>Gas Type/Units String</td>
<td>R</td>
<td>ASCII Text (set at factory)</td>
<td></td>
</tr>
</tbody>
</table>

4.2.1 Sensor Faults – Register 40005

The sensor fault status register consists of High and Low Status Bits. These bits are set/reset as faults occur or are cleared. Each Bit has a particular meaning and displayed as follows:

<table>
<thead>
<tr>
<th>Register #</th>
<th>High Byte</th>
<th>Low Byte</th>
</tr>
</thead>
<tbody>
<tr>
<td>0005</td>
<td>Status Bits</td>
<td>Status Bits</td>
</tr>
</tbody>
</table>

**NOTE** Bits read as 0 are FALSE, bits read as 1 are TRUE.

Status Bits High Byte:
- Bit 15 – Reserved
- Bit 14 – Calibration Mode
- Bit 13 – Reserved
- Bit 12 – Zero Fault
- Bit 11 – Range Fault
- Bit 10 – Reserved
- Bit 9 – Clearing Fault
- Bit 8 – Reserved

Status Bits Low Byte:
- Bit 7 – Sensor Fault
- Bit 6 – Processor Fault
- Bit 5 – Memory Fault
- Bit 4 – Reserved
- Bit 3 – Reserved
Bit 2  – Temperature Fault
Bit 1  – Auto Span Fault
Bit 0  – Global Fault
5. Service and Maintenance

Calibration Frequency

In most applications, monthly to quarterly span calibration intervals will assure reliable detection. With industrial environments varying, after initial installation and commissioning close frequency tests should be performed, weekly to monthly. Test results should be recorded and reviewed to determine a suitable calibration interval.

Visual Inspection

The Sensor should be inspected annually for the following:

- Inspect the sensor for signs of corrosion, pitting, and water damage.
- Remove the Splash Guard and inspected it for blockage, broken, cracked, or missing pieces.
- For H2S Sensor assemblies, inspect CX-IR Series Splashguard Adapter Assembly with integral filter (P/N 602-003803-200) for blockage of filter material.
- Inspect inside of the Junction Box for signs of water accumulation, signs of corrosion.
- Check wiring to ensure there are no loose or pinched wires and all connections are clean and tight.

Condensation Prevention Packet

A moisture condensation packet should be installed in every explosion proof junction box. The packet will prevent the internal volume of the J-Box from condensing and accumulating moisture due to day-night humidity changes. This packet provides a critical function and should be replaced annually.

5.1 Replacement of Plug-in Sensor

NOTE

It is not necessary to remove power while changing the plug-in toxic gas sensor in order to maintain area classification. The sensor is intrinsically safe.

NOTE

Only replace the plug-in sensor with an authorized CX-IR family of gas sensors.

Figure 14 Sensor Cell and ITM Mating
1. Use a \( \frac{1}{16}'' \) Allen wrench to release the locking setscrew that locks the ITM and splashguard adapter assembly together.

**NOTE** One turn of the setscrew will suffice - Do not remove setscrew completely.

2. Remove the splashguard. Unthread and remove the splashguard adapter assembly from the ITM.

3. Gently pull the plug-in sensor out of the ITM. Verify that the gas type and range of the new sensor cell is correct. Orient the new plug-in sensor so that it matches with the female connector pins. When properly aligned, press the sensor in firmly to make the proper connection.

4. Thread the splashguard adapter assembly onto the ITM to a snug fit and tighten the locking setscrew using the \( \frac{1}{16}'' \) Allen wrench. Reinstall the splashguard.

5. Check and perform zero calibration and span calibration in accordance with Section 3.3.

### 5.2 Replacement of ITM – Aluminum J-Box

1. Remove the power source to the sensor assembly. Disconnect all sensor wire connections at the junction box terminal board, taking note of the wire connections.

**NOTE** It is necessary to remove power to the junction box while changing the ITM in order to maintain area classification.

2. Use a wrench at the top section of the ITM and unthread the ITM until it can be removed.

3. Use a \( \frac{1}{8}'' \) Allen wrench to release the locking cap head screw that locks the ITM and splashguard adapter assembly together.

**NOTE** One turn of the setscrew will suffice - Do not remove setscrew completely.

4. Unthread and remove the splashguard adapter assembly and splash guard from the ITM. These will be re-used with the new ITM.

5. Gently remove the plug-in toxic gas sensor from the old ITM and install the sensor in the new ITM. Orient the plug-in sensor so it matches the female connector pins on the new ITM and press the sensor in firmly to make proper connection.

6. Thread the splashguard adapter assembly onto the new ITM until snug, tighten the locking cap head screw and reinstall splash guard.

7. Feed the sensor assembly wires through the \( \frac{3}{4}'' \) female NPT port and thread the assembly into the J-box until tight and the ITM faces toward the front access point. Use the locking nut to secure the ITM in this position. Re-connect the sensor assembly wires to the terminal board inside the junction box.

8. Check and/or perform Zero Calibration and Span Calibration in accordance with Section 3.3.

### 5.3 Replacement of ITM – Stainless Steel Mini Condulet

**NOTE** It is necessary to remove power to the Junction box while changing the ITM in order to maintain area classification.
1. Disconnect the sensor wire connections from the terminal board, taking note of the wire connections.

2. Use a wrench at the top section of the ITM and unthread the ITM until it can be removed.

3. Use a \( \frac{1}{8} \)" Allen wrench to release the locking cap head screw that locks the ITM and splashguard adapter assembly together.

**NOTE** One turn of the setscrew will suffice - Do not remove setscrew completely.

4. Unthread and remove the splashguard adapter assembly and splash guard from the ITM. These will be re-used with the new ITM.

5. Gently remove the plug-in toxic gas sensor from the old ITM and install it in the new ITM. Orient the plug-in sensor so it matches the female connector pins on the new ITM and press the sensor in firmly to make proper connection.

6. Thread the splashguard adapter assembly onto the new ITM until snug, tighten the locking cap head screw and reinstall splash guard.

7. Feed the sensor assembly wires through the \( \frac{3}{4} \)" female NPT port and thread the assembly into the J-box until tight and the ITM faces toward the front access point. Use the locking nut to secure the ITM in this position.

8. Re-connect the sensor assembly wires to the terminal board inside the junction box.

9. Check and/or perform Zero Calibration and Span Calibration in accordance with Section 3.3.
6. Troubleshooting Guide

If the ITM detects any functional errors the ITM will display the fault. If the sensor is experiencing a fault condition a momentary swipe of the magnet will cause the ITM to scroll the fault condition(s) across the display before the "◄" or "►" prompt will appear.

**The Display Error Codes are:**
- Auto Span Fault
- Temperature Fault
- Memory Fault
- Processor Fault
- Clearing Fault
- Range Fault
- Sensor Fault
- Zero Fault
- Sensor Fault 2

Some faults are self-explanatory, and if these faults occur and cannot be cleared the ITM should be replaced first to see if the fault will clear. Other faults may need further investigation. Some of the sensor problems, associated error codes, and resolutions are listed below.

6.1 Under-Range problems

**Probable Cause:** Sensor Baseline drifted lower, Interference gases,
- Perform Zero Calibration. Use Zero Air or N₂ source. (Section 3.3.1 AutoZero)
- Allow more time for zero stabilization if this is a biased sensor type.
- If using Splashguard with Integral Cal Port, must use Calibration Wind Guard or air movement can compromise span gas delivery.
- Execute successful Span Calibration. (Section 3.3.2 AutoSpan)
- Replace plug-in toxic sensor if error continues.

6.2 Stability problems

**Probable Causes:** Failed Sensor, empty or close to empty Cal Gas Cylinder, problems with cal gas and delivery
- Check validity of span gas using pull tube or other means (check MFG date on cal gas cylinder).
- Use proper cal gas regulators and tubing for highly corrosive gases
- If using Splashguard with Integral Cal Port, must use Calibration Wind Guard or air movement can compromise span gas delivery.
- Check for obstructions affecting cal gas hitting sensor face (including being wet, blocked, or corroded). H₂S sensors assemblies use CX-IR Series Splashguard Adapter Assembly with integral filter. Clean or replace if necessary.
- Replace the plug-in toxic sensor.

6.3 Clearing problem

**Probable Causes:** Failed Sensor, Cal Gas not removed at appropriate time, problems with cal gas and delivery, Background of Target Gas.
- The sensor must recover to < 5% of range in < 5 min after Span calibration is complete
- Use bottled air (zero air or N₂) if there is a known continuous background level.
- Check validity of span gas using pull tube or other means (check MFG date on cal gas cylinder).
- Use proper cal gas regulators and tubing for highly corrosive gases
• Check for obstructions affecting cal gas hitting sensor face (including being wet, blocked, or corroded). H2S sensors assemblies use CX_DM Series Splashguard Adapter Assembly with integral filter. Clean or replace if necessary.
• Replace the plug-in toxic sensor.

6.4 Poor Calibration Repeatability
Probable Causes: Failed Sensor, use of wrong Cal Gas or problems w/ cal gas and delivery, Interference Gases
• Check validity of span gas with regulator and sample tubing in place using pull tube or other means (check MFG date on cal gas cylinder).
• Use proper cal gas regulators and tubing for highly corrosive gases (HF, HCl, Cl2, NH3, HBR, F2, etc.)
• Check for obstructions affecting cal gas hitting sensor face (including being wet, blocked, or corroded). H2S sensors assemblies use CX-IR Series Splashguard Adapter Assembly with integral filter. Clean or replace if necessary.
• Replace the plug-in toxic sensor.

6.5 Unstable Output/ sudden spiking
Possible Causes: Unstable power supply, inadequate grounding, or inadequate RFI protection.
• Verify Power source is stable.
• Verify field wiring is properly shielded and grounded.
• Contact Detcon to optimize shielding and grounding.

6.6 Nuisance Alarms
• Check condulet for accumulated water and abnormal corrosion on terminal board.
• If nuisance alarms are happening at night, suspect condensation in condulet.
• Add or replace Detcon’s Condensation Prevention Packet P/N 960-202200-000.
• Investigate the presence of other target gases that are causing cross-interference signals.
• Determine if cause is RFI induced.

6.7 Intelligent Transmitter Module (ITM) not responding
• Verify condulet has no accumulated water or abnormal corrosion.
• Verify required batteries are installed and have enough charge to power the sensor.
• Swap with a known-good ITM to determine if ITM is faulty.

Contact the Detcon Service Department for further troubleshooting assistance at 713-559-9200.
7. Customer Support and Service Policy

Detcon Headquarters
Shipping Address: 4055 Technology Forest Blvd, The Woodlands, Texas 77381
Mailing Address: P.O. Box 8067, The Woodlands Texas 77387-8067
Phone: 713.559.9200
Fax: 281.298.2868

• www.detcon.com
• service@detcon.com
• sales@detcon.com

All Technical Service and Repair activities should be handled by the Detcon Service Department via phone, fax or email (contact information given above). RMA numbers should be obtained from the Detcon Service Department prior to equipment being returned. For online technical service, have the model number, part number, and serial number of product(s) in question available.

All Sales activities (including spare parts purchase) should be handled by the Detcon Sales Department via phone, fax or email (contact information given above).

NOTE
All additional parts must be supplied by Detcon. Use of parts from a third party will void warranty and safety approvals.

NOTE
CX-IR should only be repaired by Detcon personnel or a Detcon trained representative.

7.1 Warranty Notice

Detcon Inc. warrants the Model CX-IR gas sensor to be free from defects in workmanship of material under normal use and service for one year from the date of shipment on the transmitter electronics. See Warranty details in the CX-IR Sensor Warranty (Section 7.2).

Detcon Inc. will repair or replace without charge any such equipment found to be defective during the warranty period. Full determination of the nature of, and responsibility for, defective or damaged equipment will be made by Detcon Inc. personnel.

Defective or damaged equipment must be shipped to the Detcon Inc. factory or representative from which the original shipment was made. In all cases, this warranty is limited to the cost of the equipment supplied by Detcon Inc. The customer will assume all liability for the misuse of this equipment by its employees or other contracted personnel.

All warranties are contingent upon the proper use in the application for which the product was intended and does not cover products which have been modified or repaired without Detcon Inc. approval, or which have been subjected to neglect, accident, improper installation or application, or on which the original identification marks have been removed or altered.

Except for the express warranty stated above, Detcon Inc. disclaims all warranties with regard to the products sold. Including all implied warranties of merchantability and fitness and the express warranties stated herein are in lieu of all obligations or liabilities on the part of Detcon Inc. for damages including, but not limited to, consequential damages arising out of, or in connection with, the performance of the product.
7.2 CX-IR Sensor Warranty

**Plug-in Sensor Warranty**
Detcon, Inc., as the manufacturer, warrants under intended normal use each new CX-IR sensor to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Should the sensor fail to perform in accordance with published specifications within the warranty period, return to Detcon, Inc., for necessary repair or replacement. All warranties and service policies are FOB the Detcon facility located in The Woodlands, Texas.

**Terms & Conditions**
- The original serial number must be legible on each sensor element base.
- Shipping point is FOB the Detcon factory.
- Net payment is due within 30 days of invoice.
- Detcon, Inc. reserves the right to refund the original purchase price in lieu of sensor replacement.

**ITM Electronics Warranty**
Detcon Inc. warrants, under intended normal use, each new CX-IR Sensor ITM to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. All warranties and service policies are FOB the Detcon facility located in The Woodlands, Texas.

**Terms & Conditions**
- The original serial number must be legible on each ITM.
- Shipping point is FOB the Detcon factory.
- Net payment is due within 30 days of invoice.
- Detcon, Inc. reserves the right to refund the original purchase price in lieu of ITM replacement.
8. Appendix

8.1 Specifications

System Specifications
Sensor Type: Continuous diffusion/adsorption type
            NDIR Non-Disperse Infrared
            Sub-miniature plug-in replaceable type
Sensor Life: 5 years typical
Measuring Ranges: 0-100% LEL, 0-100% by volume
Accuracy/ Repeatability: ± 3% LEL in 0-50% LEL range, ± 5% LEL in 51-100% LEL range
Response Time: T50 < 10 seconds, T90 < 30 seconds
Warranty: 1 year

Environmental Specifications
Operating Temperature: -40°C to +75°C
Storage Temperature: -40°C to +75°C
Operating Humidity: 0-100% RH (Non-condensing)
Operating Pressure: ±10% atmospheric pressure

Electrical Specifications
Input Voltage: 7-30VDC
Power Consumption: 25mW (typical), 420mW (max)
RFI/EMI Protection: Complies with EN61326
Cable Requirements: Power/Analog: 3-wire shielded cable
                   Maximum distance is 4000 feet with 14 AWG
                   Power/RS-485: 4-wire two twisted pair shielded cable

Mechanical Specifications
Length: ITM - 5.165 inches (131 mm), 8.5 inches (215mm) with Splash Guard
Width: 2.2 inches (55 mm)
Weight: 2.5 lbs (1.2 Kg)
Mechanical Connection: ¾” Male NPT threaded connection with locking nut
Electrical Connection: five 18 gauge wire leads - 5.5” long
### 8.2 Spare Parts, Sensor Accessories, Calibration Equipment

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Spare Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>92C-IR0405-000</td>
<td>CX-IR Intelligent Transmitter Module</td>
</tr>
<tr>
<td>371-IR1I1-000</td>
<td>Replacement Plug-in toxic gas sensor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Sensor Accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td>6130</td>
<td>Sensor Rain Shield</td>
</tr>
<tr>
<td>602-003803-100</td>
<td>CX-IR Splashguard Adapter Assembly</td>
</tr>
<tr>
<td>327-000000-000</td>
<td>Programming Magnet</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Calibration Accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td>943-000000-000</td>
<td>Calibration Wind Guard</td>
</tr>
<tr>
<td>943-000006-132</td>
<td>Threaded Calibration Adapter</td>
</tr>
<tr>
<td>943-050000-132</td>
<td>Span Gas Kit: Includes calibration adapter, span gas humidifier, 500cc/min fixed flow regulator, and carrying case. (Not including gas).</td>
</tr>
<tr>
<td>See Detcon</td>
<td>Span Gases – various</td>
</tr>
<tr>
<td>943-05AM00-000</td>
<td>500 cc/min Fixed Flow Regulator for span gas bottle</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Optional Accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td>897-860000-316</td>
<td>316SS Mini Condulet w/Solid Cover</td>
</tr>
<tr>
<td>960-202200-000</td>
<td>Condensation prevention packet (For Condulet, replace annually)</td>
</tr>
</tbody>
</table>
### 8.3 Revision Log

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Changes made</th>
<th>Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>3/27/2013</td>
<td>Release</td>
<td>LBU</td>
</tr>
<tr>
<td>1.1</td>
<td>01/29/14</td>
<td>Update wiring, calibration and other corrections</td>
<td>LBU</td>
</tr>
<tr>
<td>1.2</td>
<td>05/29/14</td>
<td>Added Section 2.1, Updated Approvals Label</td>
<td>BM</td>
</tr>
</tbody>
</table>